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RESEARCH MEMORANDUM

for the

Bureau of Aeronautics, Department of the Navy

AN INVESTIGATION OF THE SPRAY CHARACTERISTICS OF A JET-POWERED DYNAMIC MODEL OF THE DR 56 FLYING BOAT WITH A VEE TAIL

TED NO. NACA DE 328

By Arthur W. Carter

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Langley Field, Va.

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AN INVESTIGATION OF THE SPRAY CHARACTERISTICS OF A JET-POWERED DYNAMIC MODEL OF THE DR 56 FLYING BOAT WITH A VEE TAIL

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SUMMARY

An investigation was made of the spray characteristics of a jet-powered dynamic model of the DR 56 flying-boat design with a vee tail. The results indicated that the tail surfaces, located at the lowest vertical position desirable from aerodynamic considerations, provided satisfactory spray clearance in smooth and rough water. Results from a limited number of tests indicated that the longitudinal stability and behavior during take-off and landing in smooth water and in waves 8 feet high (full size) were approximately the same with the vee tail as with the basic tail.

INTRODUCTION

The hydrodynamic characteristics of a jet-powered dynamic model of the Navy Bureau of Aeronautics DR 56 flying-boat design have been presented in reference 1. As reported in this reference, the forebody spray striking the outboard portion of the horizontal surfaces of the basic tail at high speeds was heavy and caused damage to the tail surfaces; thus, excessive maintenance of the full-size airplane might be expected. The tests indicated that the horizontal surfaces, if raised approximately 5 feet, would be relatively clear of the forebody spray. Another possible solution would be the use of a vee tail in which the outboard portions would be above the forebody spray.

The present investigation of a vee-tail design therefore was made to determine whether vee-tail surfaces, which were located at the lowest vertical position desirable from aerodynamic considerations, provided satisfactory spray clearance in smooth water and in waves 8 feet high (full size). In addition, a limited investigation was made to determine the effect of the change of tail design on the take-off and landing behavior.

MODEL, APPARATUS, AND PROCEDURE

The model was the same as Langley tank model 248 (reference 1) with the exception of the tail surfaces. Drawings of the vee-tail surfaces were furnished by the Bureau of Aeronautics and the tail was constructed at the Langley Aeronautical Laboratory.

Photographs of the model and general arrangement of the flying-boat design are shown in figures 1 and 2, respectively. The tail surfaces of the basic model (reference 1) are shown in figure 2 for comparison with the vee tail. The basic tail has 370 square feet of horizontal surfaces and 280 square feet of vertical surfaces. The vee tail has 700 square feet of area plus 65 square feet of vertical pylon. The vertical location of the vee tail was the lowest desirable from aerodynamic considerations. Details and dimensions of the vee tail are shown in figure 3.

The investigation was made in Langley tank no. 1, which is described in reference 2. The setup of the model on the towing apparatus and the test procedures were the same as those described in reference 1.

RESULTS AND DISCUSSION

Aerodynamic-trim data for the model with the two types of tail are shown in figure 4 where trim (angle between forebody keel at step and horizontal) is plotted against elevator deflection for the power-off condition. Higher trims were obtained for the model with the vee tail at all elevator deflections. The model with the vee tail trimmed against the stop (25°) at an elevator deflection of -15° for all flap settings.

Based on the data from a limited number of test runs, the longitudinal stability and behavior during take-off and landing in smooth water and in waves 8 feet high (full size) were approximately the same for the model with the vee tail as for the model with the basic tail. The skeg on the keel at the sternpost (reference 1) was installed on the model before it was landed as a free body. The model with the vee tail appeared to have slightly less directional stability during these free-body landings than the model with the basic tail having 11 percent added fin area.

The drifting characteristics were approximately the same for the model with vee-tail surfaces as with the basic tail.

The smooth-water spray characteristics during take-off with power are shown in the photographs of figure 5. Three views are shown at each speed in order to indicate more clearly the spray in the vicinity of the tail surfaces. At the lowest speed a small quantity of spray flowed over the aft fuselage and base of the vee tail, but the tail surfaces were essentially clear of spray at all higher speeds. The vertical position of the vee tail, as specified by the Bureau of Aeronautics, provided satisfactory spray clearance during take-off.

Photographs of spray during power-off landings are compared for the model with the vee and basic tails in figure 6. The vee-tail surfaces were essentially clear of spray throughout the landing-speed range, whereas forebody spray struck the horizontal surfaces of the basic tail over a large speed range.

No heavy spray struck the vee-tail surfaces during take-offs and landings in waves 8 feet high (full size). Some water flowed over the tail at the base of the vee at low speeds but did not cause structural damage to the model.

CONCLUDING REMARKS

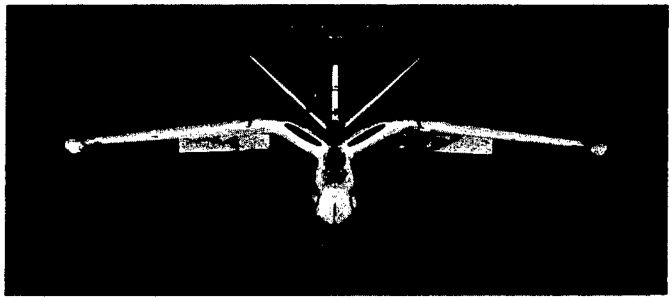
The results of the spray investigation indicated that the vee-tail surfaces, which were located at the lowest vertical position desirable from aerodynamic considerations, provided satisfactory spray clearance in smooth and rough water. Results from a limited number of tests indicated that the longitudinal stability and behavior during take-off and landing in smooth water and in waves 8 feet high (full size) were approximately the same with the vee tail as with the basic tail.

Langley Aeronautical Laboratory
National Advisory Committee for Aeronautics
Langley Field, Va.

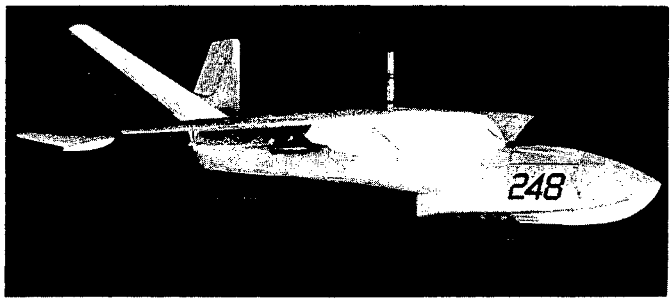
REFERENCES

1. Carter, Arthur W., West, Max D., and Bryce, Paul W., Jr.: An Investigation of the Hydrodynamic Characteristics of a Jet-Powered Dynamic Model of the DR 56 Flying Boat - TED No. NACA DE 328. NACA RM SL51A03, 1951.

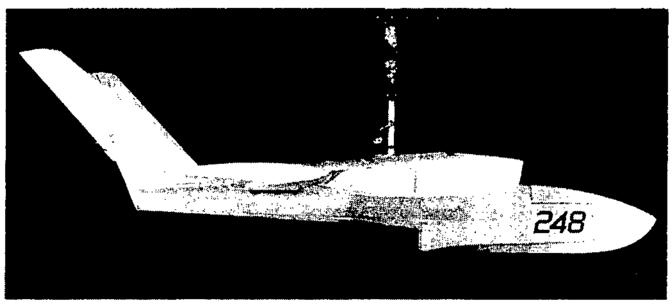
2. Truscott, Starr: The Enlarged N.A.C.A. Tank, and Some of Its Work. NACA TM 918, 1939.



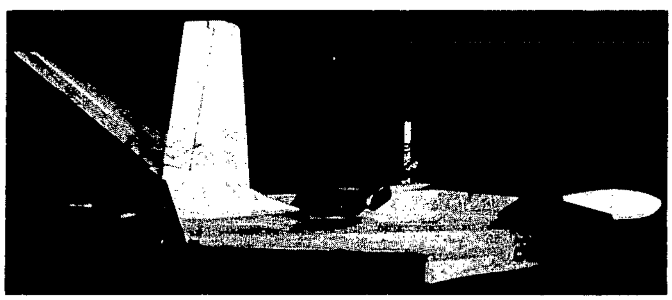
Front view



Three-quarter front view



Three-quarter rear view



Three-quarter rear view

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Figure 1.- Langley tank model 248 with vee tail.

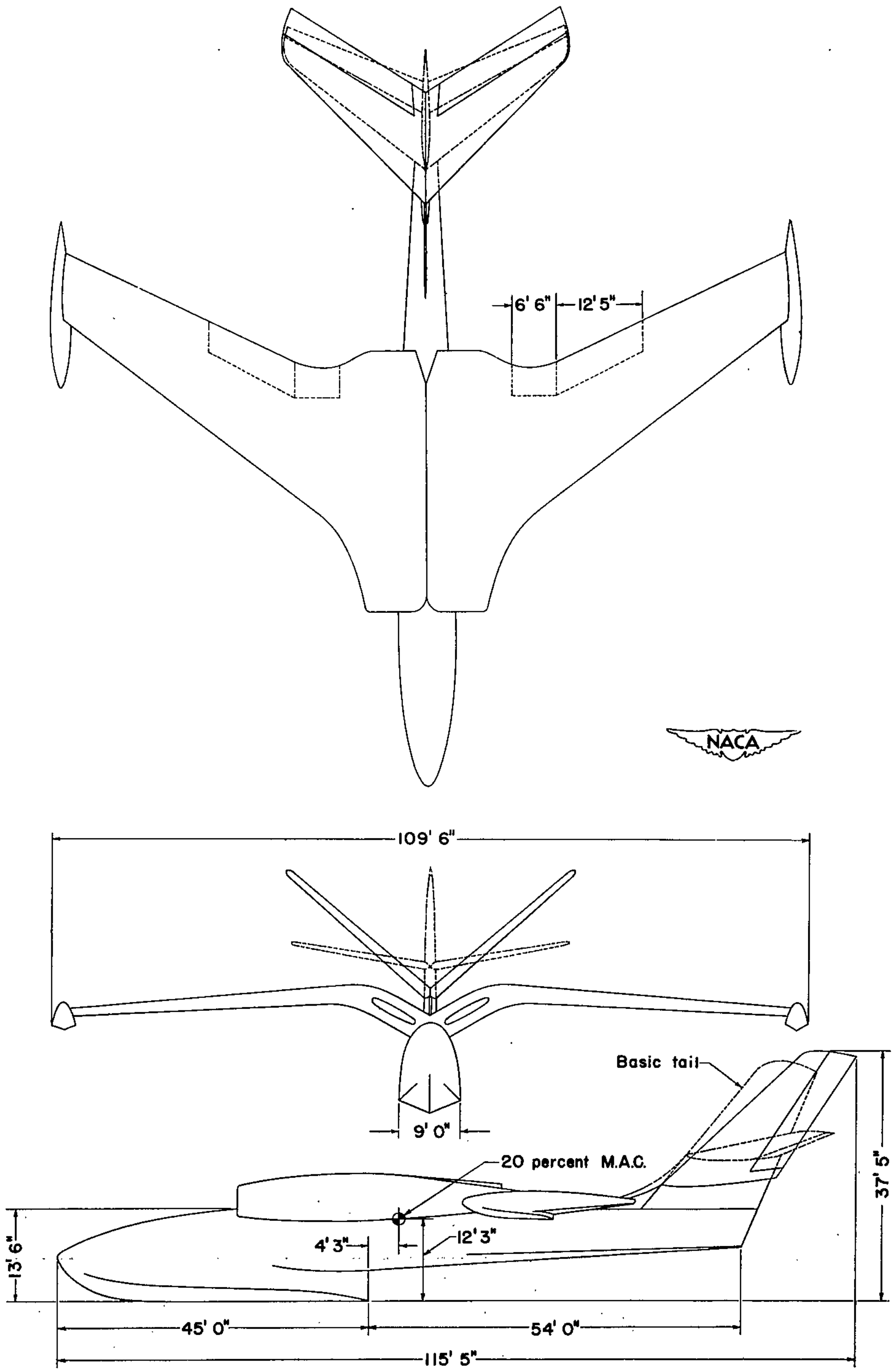

Figure 2.- General arrangement.

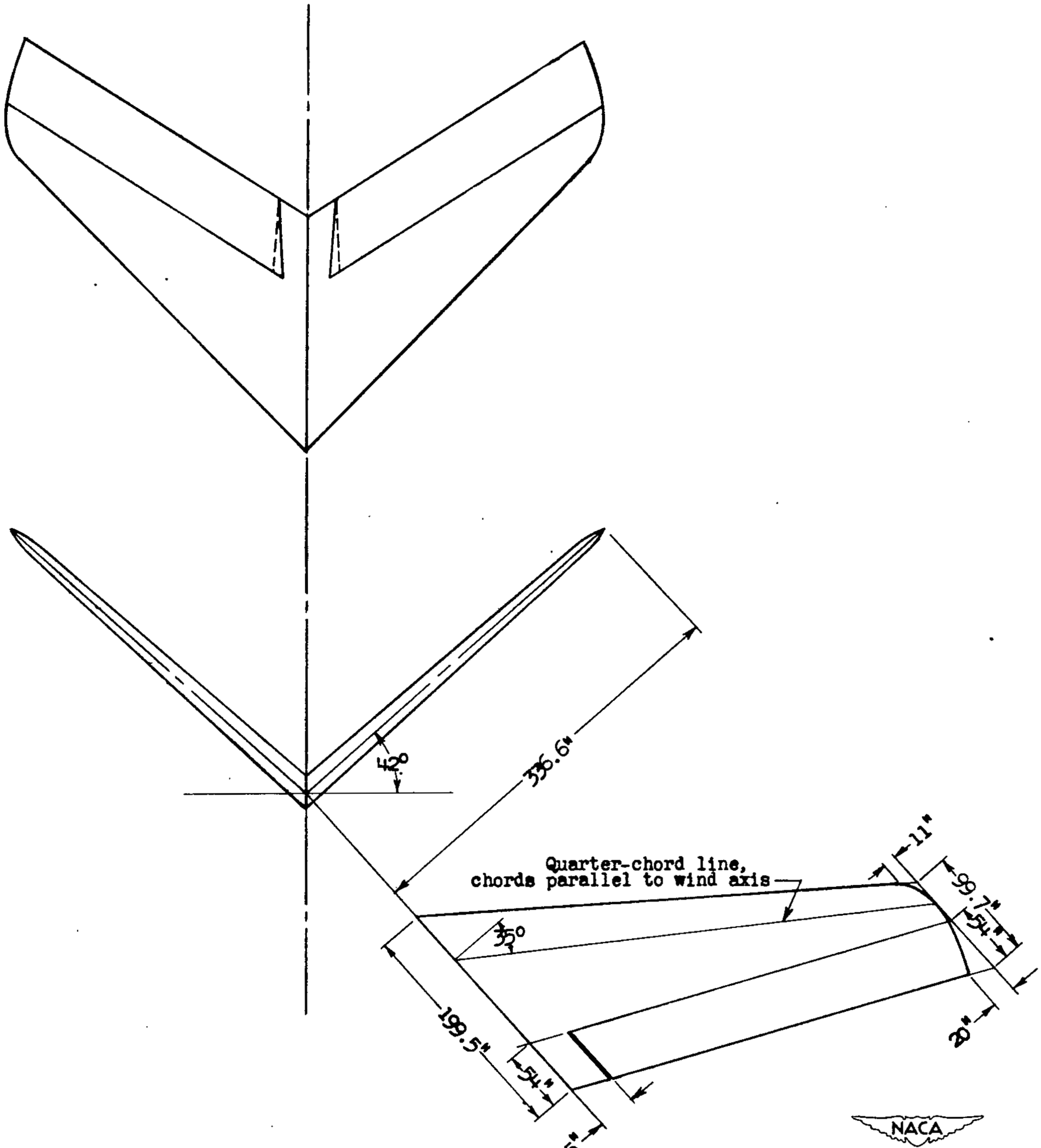

Figure 3.- Details of vee-tail surfaces.

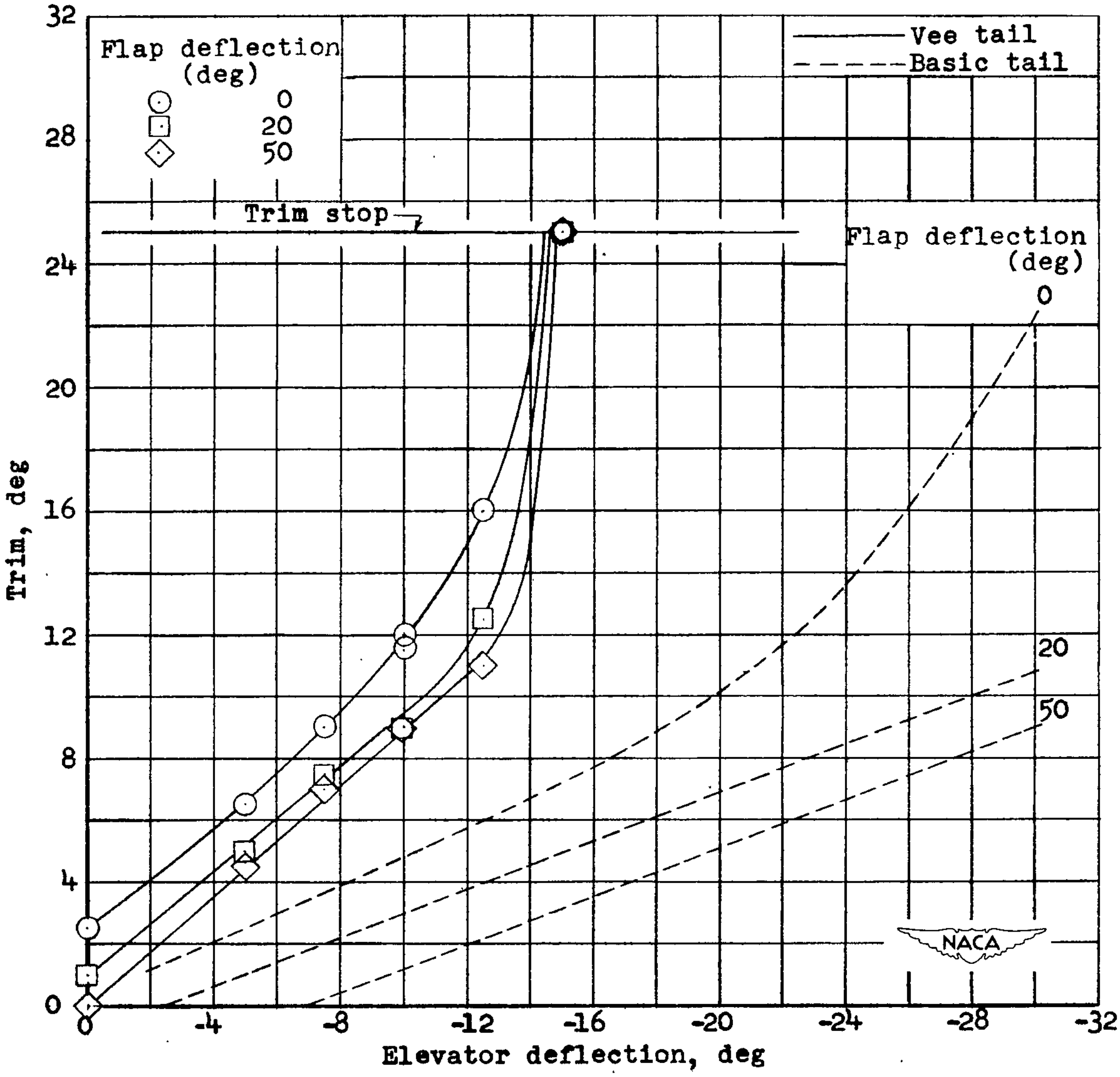

Figure 4.- Variation of trim with elevator deflection. Center of gravity, 26 percent mean aerodynamic chord; speed, 100 knots.

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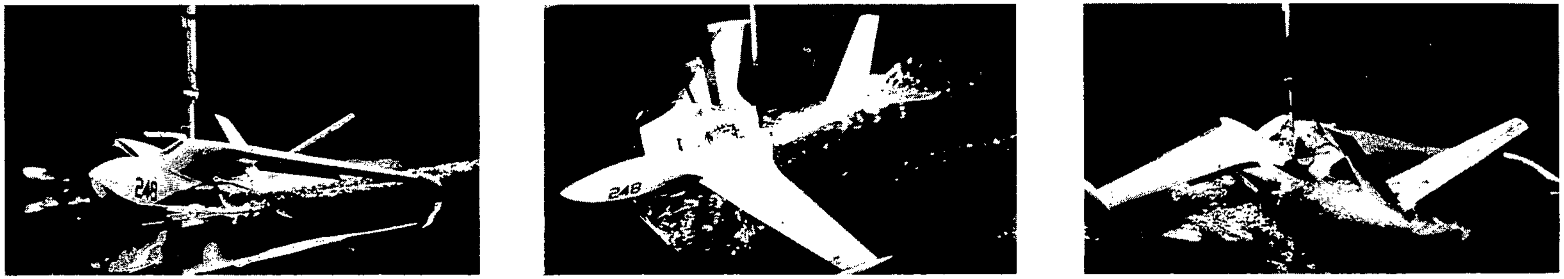
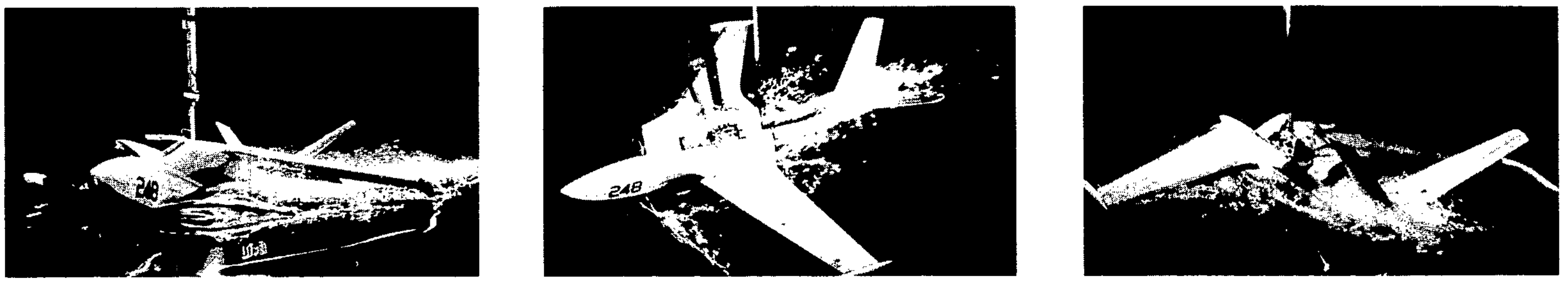
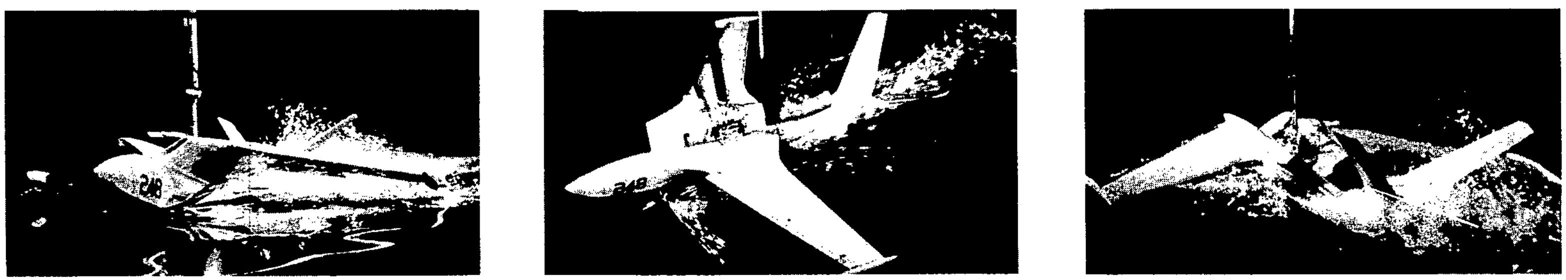


Speed, 24.4 knots; trim, 10.0°



Speed, 29.3 knots; trim, 12.0°



Speed, 34.2 knots; trim, 12.0°

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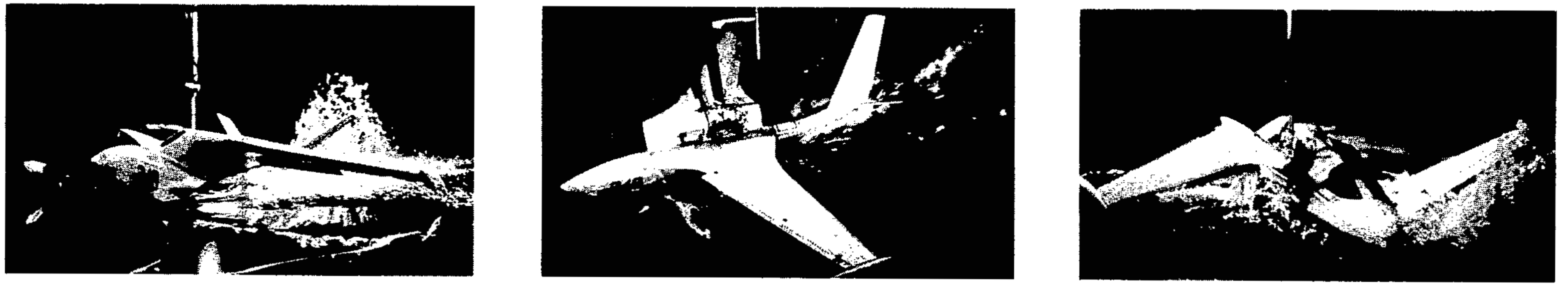
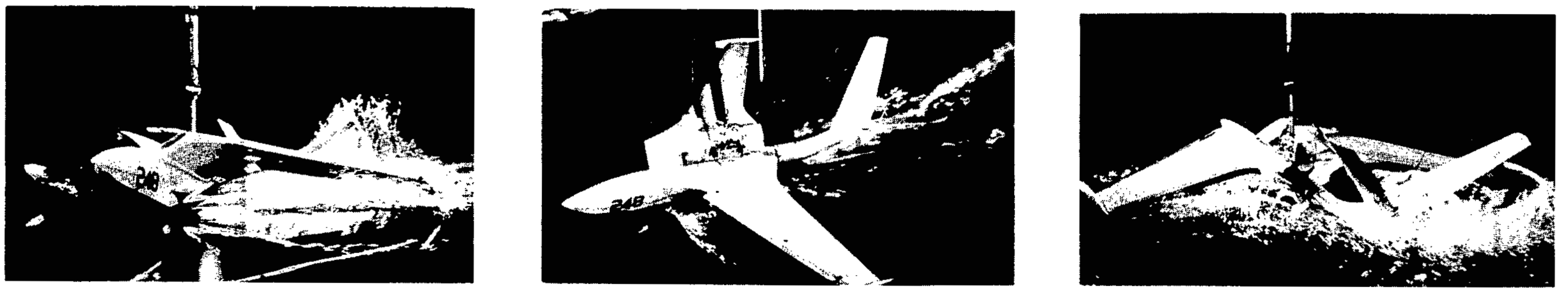
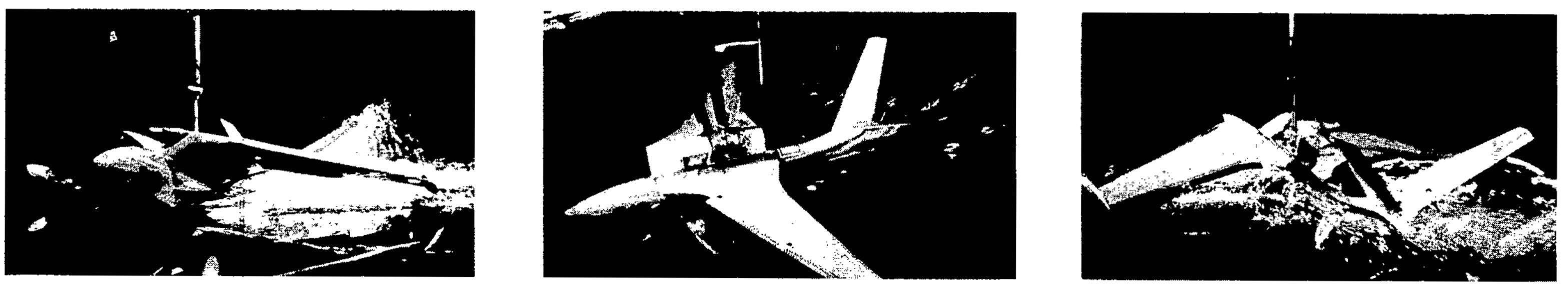
Figure 5.- Spray characteristics. Power on; gross load, 130,000 pounds; flap deflection, 20°; elevator deflection, -10°; center of gravity, 28 percent mean aerodynamic chord.



Speed, 39.0 knots; trim, 12.0°



Speed, 43.9 knots; trim, 12.0°



Speed, 48.8 knots; trim, 12.0°

Figure 5.- Continued.

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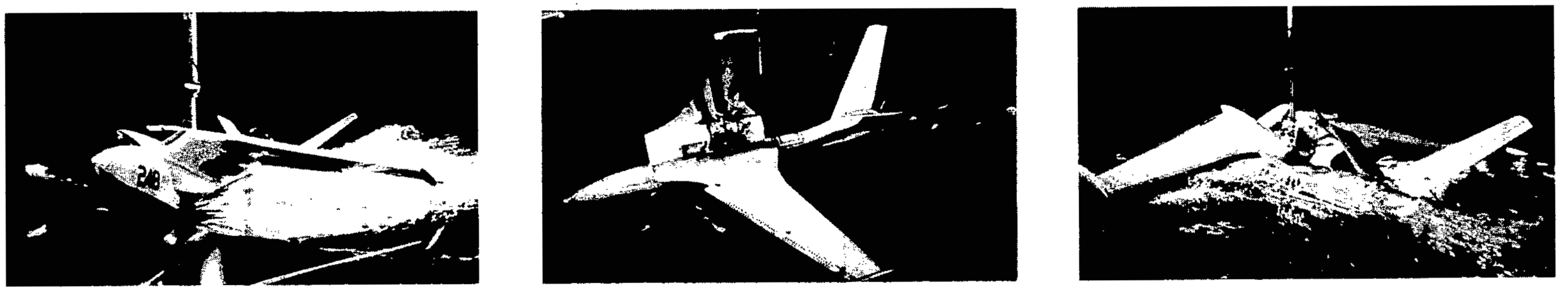
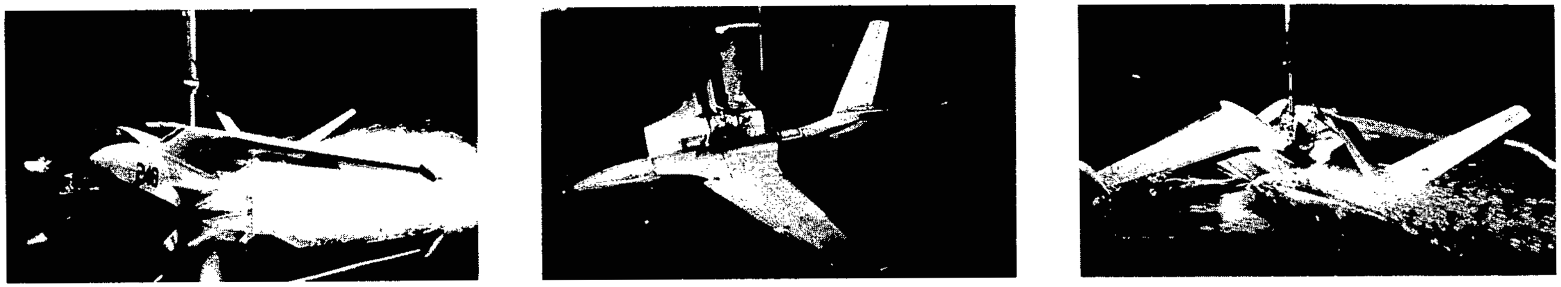
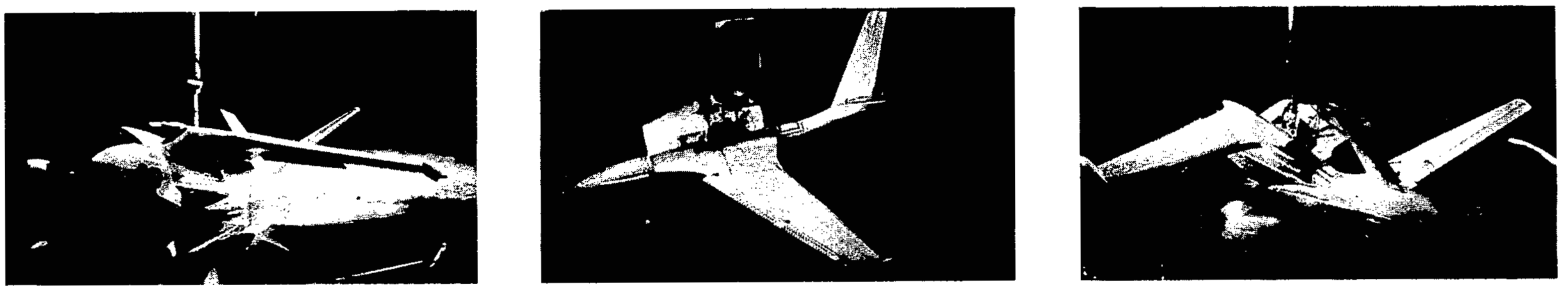


Speed, 61.0 knots; trim, 11.5°



Speed, 85.4 knots; trim, 11.5°



Speed, 109.8 knots; trim, 11.5°

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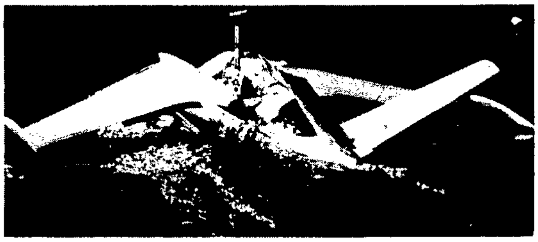
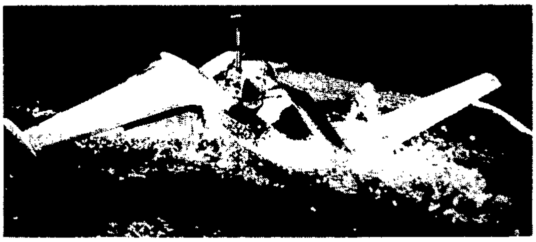
Figure 5.- Concluded.



Trim, 10.5°

Speed, 24.4 knots

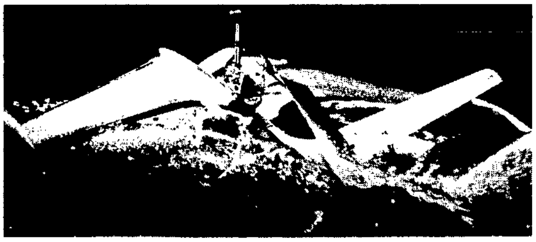
Trim, 10.5°

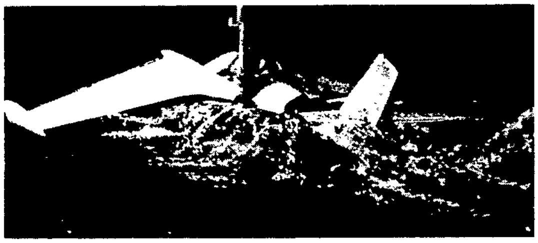


Trim, 13.0°

Speed, 36.6 knots

Trim, 12.5°





Trim, 12.5°

Speed, 48.8 knots

Trim, 12.5°

Trim, 12.0°

Speed, 61.0 knots

Trim, 12.5°

(a) Vee tail.

(b) Basic tail.

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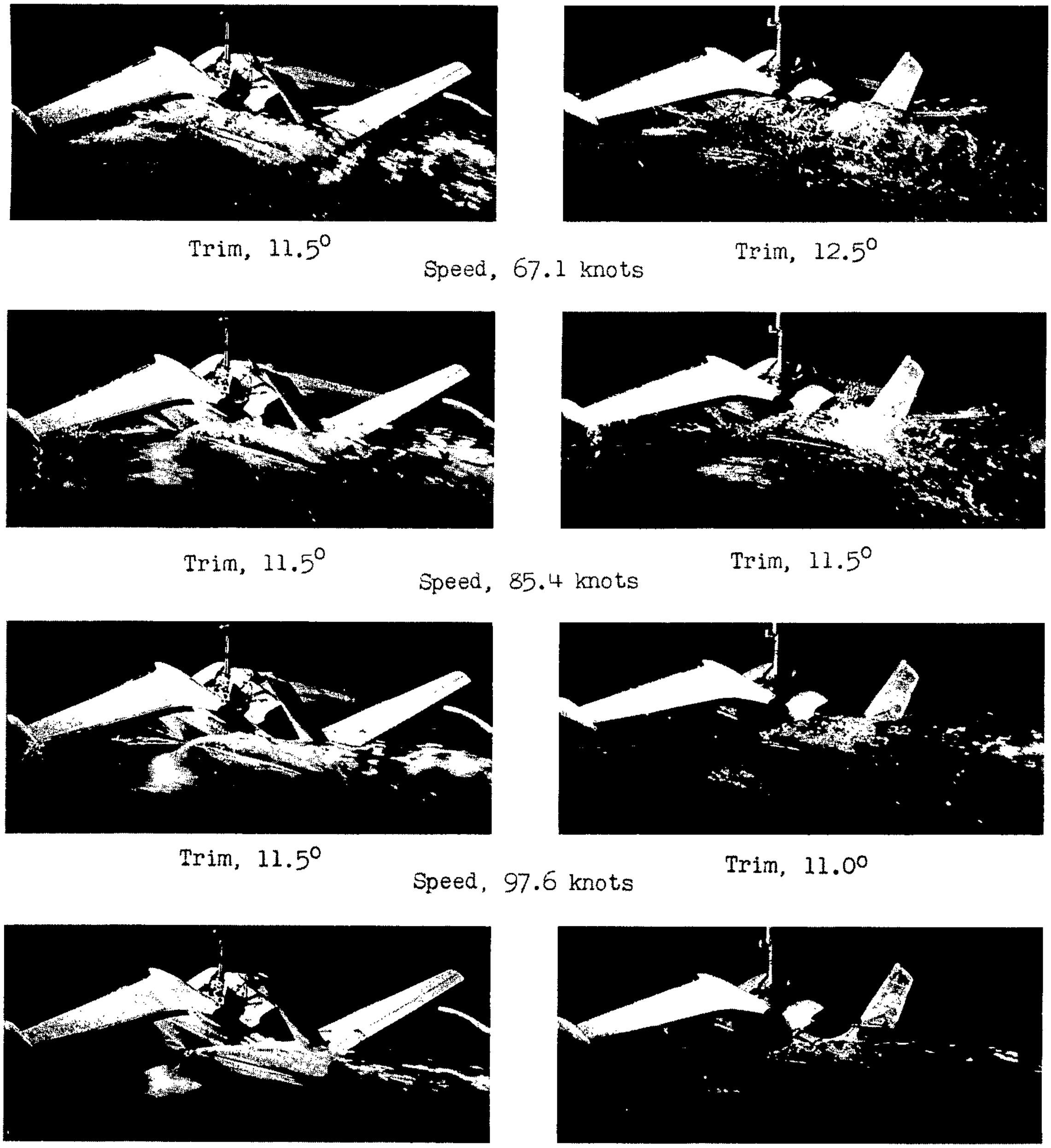
Figure 6.- Comparison of spray on vee and basic tails. Power off; gross load, 130,000 pounds; flap deflection, 20°; elevator deflection, -10°; center of gravity, 28 percent mean aerodynamic chord.



Trim, 11.5° Speed, 67.1 knots Trim, 12.5°

Trim, 11.5° Speed, 85.4 knots Trim, 11.5°

Trim, 11.5° Speed, 97.6 knots Trim, 11.0°

Trim, 11.5° Speed, 109.8 knots Trim, 10.5°

(a) Vee tail. (b) Basic tail.

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Figure 6.- Concluded.

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